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I vividly recall the emotions I felt as an apprentice weapons diagnostician at the Nevada Test Site (NTS) on September 23, 1992. That's the day we executed the Divider event, the last nuclear test conducted by the United States. For most of us there that day, the satisfaction of a job well done was mixed with a feeling of great uncertainty: the test moratorium loomed large on the horizon.

At the same time, I was an experimental user at LANSCE, and LANSCE, too, was facing a difficult period of transition. The DOE nuclear science program that had established the facility and operated it since 1972 was winding down after years of successful application. Nuclear physics was moving in other directions.

Today, I feel an optimism that stands in contrast with my memories of 1992 as I consider how the Stewardship Program has come together and the exciting science that researchers at LANSCE contribute to it.

In 1994, when John Immele and John Browne asked me to take on the stewardship program at LANSCE, a number of visionary people from divisions across the Laboratory had already developed a white paper with compelling ideas on potential stewardship applications using LANSCE's capabilities in materials and nuclear science. The central themes put forth in that paper remain current, but our work has evolved in ways we could never have predicted, developing as a set of wonderful and elaborate "connection stories" within the broader context of stewardship—and isn't that the nature of science?

For example, proton radiography actually grew from our initial efforts to develop neutron radio-graphy as a stockpile surveillance tool. Chris Morris's inspiration on magnetic focusing of high-energy proton beams provided an answer to a question that occurred to him while working on neutron radiography: how could one make radiographic imaging quantitatively more accurate and still FAST?

In the beginning, we saw 800-MeV proton radiography at LANSCE as a forerunner to full hydrotest imaging at very high energies (25 GeV and above). At the time, in 1997, Livermore had the initiative on an x-ray-based advanced hydro-test facility (AHF) that was threatening to stall DARHT's second axis. Proton radiography offered an extraordinary level of capability for an AHF, and it became clear that going prematurely into a next-generation x-ray machine and leaving DARHT half-finished would be a terrible mistake.

In the midst of all this, John Sarracino realized that the 800-MeV protons at LANSCE offered a powerful tool for weapons hydrodynamics studies on a smaller scale. Since then, we've been captivated by the steady stream of remarkable multiframe images of all manner of hydrodynamics experiments, including detonation waves in cold insensitive high explosives, metal jets, fliers, and, thanks to Nick King's work with our British colleagues, images of implosions as well. The wealth of information we derive from these experiments will no doubt continue to increase as we enjoy safe and convenient operations in our refurbished p-rad facility and, given DOE approval of the new Hazard Analysis spearheaded by Mary Hockaday, a 10-pound load limit in a 6-foot containment vessel!

The establishment of the germanium array for neutron-induced excitations, or GEANIE, at the Weapons Neutron Research (WNR) facility grew from Livermore colleague John Becker's realization that the best way to study certain neutron reactions is by detecting the gamma rays that emerge from the nucleus that is left behind. John's Livermore team, in collaboration with Ron Nelson and others at LANSCE, along with

Mark Chadwick in our Theoretical Division, have applied this idea to a long-standing issue in primary radiochemistry: the cross section for the reaction ^{239}Pu + n eutron _ _^{238}Pu + 2 neutrons. These collaborators are now applying GEANIE to other measurements that will settle important issues in weapons radchem analysis which will confront us in the context of ASCI.

In an amazing twist of serendipity, we were able to produce the special, americium-free plutonium target used in the GEANIE experiment as a by-product of our efforts at TA-55 to grow large single crystals of plutonium for equation-of-state (EOS) studies at LANSCE's Lujan Center.

What we now call neutron resonance spectro-scopy (NRS) had actually been used in some remarkable EOS experiments that Sonny Ragan conducted in Nevada using neutrons from nuclear explosions. What Sonny has told me he finds remarkable is that NRS is possible without a bomb as his neutron source! Enabling this is LANSCE's 800-MeV proton storage ring (PSR), which provides us with the highest peak flux neutron source in the world. Dave Funk, Ron Rabie, and Larry Hull have developed novel and exciting designs for shockwave physics and hydrodynamics experiments using NRS. After long experimental development and patient waiting for precious "sole-use" LANSCE beam, Vinny Yuan's NRS team is now poised to bring these efforts to fruition.

In materials science research at LANSCE's Lujan Center, there have been a number of surprising developments. Bob Von Dreele was able to provide measurements of crystallographic texture in stockpile (Rocky Flats) plutonium using a
powerful combination of tools: the high- intensity powder diffractometer (HIPD), his world-renowned neutron diffraction analysis software, and a lot of running time! We were very surprised that he was able to do neutron scattering experiments on the highly absorbing 239 isotope of plutonium (the far more trans-parent 242 isotope is generally used in neutron scattering experiments).

Yusheng Zhao invented a resistively-heated high-pressure sample holder that enables
precision temperature control up to 1000_C in a diamond anvil cell for EOS experiments with neutrons—the best of its kind. Angus Lawson's plutonium science efforts have yielded intriguing data on anomalous high-temperature softening of the interatomic potential in delta-plutonium. Neutron diffraction measurements by Don Brown on uranium-niobium samples under stress have elucidated mechanisms of the anomalous stress-strain behavior of these alloys. Joe Mang and Rex Hjelm have used small-angle neutron scattering (SANS) to characterize HE microporosity as a function of insult damage. Such experiments, employing contrast variation techniques developed specifically for explosives, move us toward a more fundamentally grounded approach to understanding HE sensitivity.

LANSCE's replacement cost in today's world has been estimated at a billion dollars. Obviously, operation and maintenance of a facility of this size, complexity, and age requires a significant investment. In hindsight, it is clear that that investment was simply not made during the closing years of LANSCE's founding program. It was no big surprise to learn that critical infrastructure items would need to be replaced early in the era of stewardship, but we did experience some initial sticker shock. It has taken us some time to get our arms around what it will take to sustain LANSCE's infrastructure in the long term, to run the facility in compliance with more stringent ES&H standards, and to obtain an authorization basis for operations in today's regulatory environment.

As it looks today, the news is pretty good. LANSCE's major components—the WNR, the PSR, the Lujan Center, the proton-radiography facility, and the 800-MeV linac that provides beam to all these elements—are all capable of good service for decades into the future—provided we continue down the present path of improved maintenance. This past summer, LANSCE passed a DOE readiness assessment enabling it to resume operations of the Lujan target as a Category 3 nuclear facility within an accelerator complex—a unique feature on DOE’s regulatory landscape. During the past year, the linac has operated as long and as well as it has any time in its history.

LANSCE’s landlord since 1995 has been DOE/DP, but many of LANSCE’s activities are substantially leveraged through resources invested by offices other than DOE/DP. For example, a partnership between DOE/DP and DOE’s Office of Science (SC) at the Lujan Center is particularly valuable to LANSCE and mutually beneficial to DP and SC. SC provides a majority contribution to the Lujan Center’s annual operating budget and is funding five new state-of-the-art neutron scattering instruments (an investment of about $25M).

By operating and maintaining the linac and other major infrastructure, DP supports both basic research and stewardship activities. In addition, bringing together DP and non-DP researchers at LANSCE enhances stewardship science and helps recruit new talent to Los Alamos. LANSCE is, in fact, the only facility at a DP laboratory that has a truly national profile.

All of us who work at LANSCE are committed to helping the Laboratory meet the challenges of stockpile stewardship. Through ALDNW’s Experimental Programs office, we are directly supporting work in five of the stewardship campaigns. However, LANSCE beam time and other experimental resources are certainly not restricted to users funded by that program.

LANSCE is a user facility for the nation, and that means that it offers its capabilities free of charge to individuals with good research ideas. I, personally, will connect you with the people who can best help you pursue your research ideas. We welcome new users and encourage you to come and have a look at all that LANSCE has to offer.